



65258 - R8 CAA

10-22-13

US EPA
Source Test Report

XTO Energy, Inc.
RBU 11-18F Facility,
Utah

September 18, 2013

Permit: N/A

Engine: Caterpillar G3606LE

SN: 3XF00121

Unit ID: #1

Prepared By:

Oasis Emission Consultants, Inc.
2730 Commercial Way
Rock Springs, WY 82901





October 22, 2013

Ms. Rykki Tepe
XTO Energy, Inc.
810 Houston Street
Fort Worth, TX 76102

Dear Ms. Tepe:

**Re: Engine Emission Testing For XTO Energy, Inc., RBU 11-18F Facility
Unit #1.**

Oasis Emission Consultants, Inc. was requested to perform an engine emission test on a Caterpillar G3606LE lean burn engine located on tribal land in Utah.

Emission Levels

The average recorded levels were found to comply with emission levels stipulated in the guidelines of the EPA Consent Decree, as shown in the attached report, and summarized below.

Emission Unit	Avg NOx	Avg CO
gr/BHP-hr	0.58	0.04
lbs/hr	1.55	0.12

Formaldehyde Levels

Test Run	HCOH (ppm)	HCOH @ 15% O2 (ppm)	HCOH @ 15 % O2 Limit
1	19.22	12.06	14
2	18.28	11.47	14
3	19.81	12.56	14
AVG	19.10	12.03	14

Catalyst Parameters

Test Run	Inlet Temp (°F)	DP (in H2O)
1	734	2.2
2	735	2.1
3	735	2.2
AVG	735	2.2

Engine Load

Test Run	BHP
1	1168.5
2	1223.9
3	1225.4

Testing Protocol

The attached report was generated using an extractive FTIR system using methodologies as required by ASTM D6348 – 03 and/or EPA 40 CFR 63(A) Method 320.

Quality Assurance

Oasis has performed a full cursory review of the raw data and calculated results in this report. Any errors we have encountered have been listed in the body of this report. After performing the review, we are confident that this engine has met the requirements of the Consent Decree.

If you have any questions or require further information, please contact the undersigned at (307) 382-3297.

Yours truly,
Oasis Emission Consultants, Inc.



Christopher N. Knott, P.Eng.
Director, Engineering & Operations

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SOURCE EMISSION TEST REPORT

PERMIT N/A

Test Performed By: Oasis Emission Consultants, Inc.

Facility Name: RBU 11-18F Facility
 Unit #1

Emission Source: Caterpillar G3606LE

Date of Test: September 18, 2013

Date of Report: October 22, 2013

1.1 Introduction

The purpose of this source test was to demonstrate that source emissions from a Caterpillar G3606LE engine do not exceed maximum allowable levels specified by guidelines issued in EPA's Consent Decree.

The Caterpillar G3606LE engine is a lean burn engine that employs an Oxidation Catalytic Convertor to regulate emission levels.

Three test runs were performed on September 18, 2013 to analyze NOx, CO & HCOH emission levels according to methodologies outlined in the ASTM D 6348-03 & EPA 40 CFR 63(A), Method 320 Protocol. Effluent exhaust was sampled from the engine through an extractive heated stainless steel sample line interconnected to an MKS 2030 FTIR analyzer.

Each of the three runs consisted of sixty (60) readings taken at one (1) minute intervals.

Test runs were observed by the following individuals:

- Jeff Arsenault, Oasis Emission Consultants, Inc.
- Derrick, XTO Energy, Inc.

2.1 Equipment Utilization

The following equipment was used during the tests performed at this facility in conjunction with procedures outlined by ASTM D 6348-03 & EPA 40 CFR 63(A), Method 320.

- (1) MKS MultiGas 2030 FTIR Continuous Gas Analyzer
- (1) Laptop Computer For The FTIR Analyzer Using MKS MG2000 Software
- (1) 30ft or 100ft Heated Teflon Line w/ Heated Sample Probe & Spike Bypass Line
- (1) Fyrite O₂/CO₂ Analyzer
- (6) EPA Protocol G1 Calibration Gas (CO, NOx, C₂H₄, CH₃CHO, C₃H₈ & NO₂)

The MKS Multigas 2030 FTIR Analyzer was used to measure NOx & CO on a dry basis. Formaldehyde levels were measured on a wet basis and were corrected to produce levels on a dry basis. A pre Direct and System calibration measurement was made on compounds of NOx, CO, CH₃CHO, C₃H₈ & C₂H₄. In addition, a post Direct calibration was made on compounds of NOx, CO, CH₃CHO & C₃H₈. A post System calibration was also conducted for C₂H₄. Compounds of CO₂, CO, NO, CH₃CHO & C₃H₈ were measured for the quality assurance spiking requirements of ASTM D 6348-03 & EPA 40 CFR 63(A), Method 320

When a gas sample is introduced in the gas cell, the infrared beam is partially absorbed by the gas species present. The spectral frequencies absorbed and their intensity are due to the atoms associated with the chemical bond and the strength of that bond. The absorption spectrum is unique for each infrared-active gas. The MKS Analyzer measures the absorption spectrum, and its analysis algorithm measures the concentration of each gas using pre-loaded calibrations. The MG2000 software allows for the continuous measurement, display and recording of the sample stream.

The MKS Multigas 2030 FTIR Analyzer operated with a spectral resolution of 0.5 cm⁻¹ and a scan time of 30 seconds. The FTIR spectrometer utilizes a multi-pass gas cell with a 5.11 meter effective pathlength.

3.1 Discussion Of NOx, CO & HCOH Test Results

Please refer to Appendix A for the raw NOx, CO & HCOH test results. Please refer to Appendix B for a listing of all raw data, calibration error response and calculations performed per ASTM & EPA requirements. Overall the average emission levels complied with Consent Decree guidelines on a gr/BHp-hr basis. Testing for NOx, CO & HCOH were run concurrently with one another.

3.1.1 Source Test 1: Caterpillar G3606LE, NOx, CO & HCOH

The first test was performed from 9:48 to 10:47 for NOx, CO & HCOH.

The average NOx and CO levels were found to be **0.58 gr/BHP-hr and 0.04 gr/BHP-hr** respectively. The Formaldehyde level was found to be **12.06 ppm @ 15% O₂**, which tested in compliance with the current EPA standards.

Test Run	NOx (ppm)	NOx (gr/BHP-hr)	CO (ppm)	CO (gr/BHP-hr)	HCOH (ppm)	HCOH @ 15% O ₂ (ppm)
1	58.47	0.58	6.55	0.04	19.22	12.06

3.1.2 Source Test 2: Caterpillar G3606LE, NOx, CO & HCOH

The second test was performed from 10:56 to 11:55 for NOx, CO & HCOH.

The average NOx and CO levels were found to be **0.59 gr/BHP-hr and 0.04 gr/BHP-hr** respectively. The Formaldehyde level was found to be **11.47 ppm @ 15% O₂**, which tested in compliance with the current EPA standards.

Test Run	NOx (ppm)	NOx (gr/BHP-hr)	CO (ppm)	CO (gr/BHP-hr)	HCOH (ppm)	HCOH @ 15% O ₂ (ppm)
2	59.94	0.59	6.89	0.04	18.28	11.47

3.1.3 Source Test 3: Caterpillar G3606LE, NOx, CO & HCOH

The third test was performed from 12:06 to 13:05 for NOx, CO & HCOH.

The average NOx and CO levels were found to be **0.59 gr/BHP-hr and 0.05 gr/BHP-hr** respectively. The Formaldehyde level was found to be **12.56 ppm @ 15% O₂**, which tested in compliance with the current EPA standards.

Test Run	NOx (ppm)	NOx (gr/BHP-hr)	CO (ppm)	CO (gr/BHP-hr)	HCOH (ppm)	HCOH @ 15% O ₂ (ppm)
3	59.01	0.59	8.08	0.05	19.81	12.56

4.1 Stack Sampling Location

The sampling port for moisture, flow, NOx, CO and HCOH measurements was approximately 3' from the nearest upstream flow disturbance and 5' from the nearest downstream disturbance.

4.2 Stack Sampling Methods & Procedures

Testing followed EPA 40 CFR 63(A), Method 320 and/or ASTM D6348-03 methodologies per our standard protocol, with no exceptions.

5.1 Quality Assurance

CTS procedures were followed according to ASTM requirements for both pre and post testing. Similarly, QA spiking procedures were followed. Analysis of the CO₂ exhaust effluent was used to determine the dilution factor. Steady levels of the CO₂ were observed and a sufficient duration of time was allowed to elapse for a representative average.

The calibration gas was spiked into the effluent stream using a bypass line at approximately 10% of the sampling rate. The dilution factor was obtained from observation of the stack CO₂ behavior using the following equation:

$$DF = \frac{CO_2_{AVG} - CO_2_{SPIKE}}{CO_2_{AVG}}$$

Where: CO₂_{AVG} = The average undiluted CO₂ stack gas concentration of spike measurements
CO₂_{SPIKE} = The average diluted CO₂ stack gas concentration when spiked

The sample recovery was then obtained from the following equation:

$$\% REC = \frac{(Spike_{MEAS} - Stack_{MEAS}) * (1 - DF)}{CS * DF}$$

Where: Spike_{MEAS} = The average diluted stack gas concentration when spiked
Stack_{MEAS} = The average undiluted stack gas concentration
DF = Dilution factor
CS = Certified concentration of calibration standards

The Sample Recovery average level for NO, CO, C₃H₈ & CH₃CHO was found to be 95.0%, 96.6%, 95.3% & 124.3% respectively, which was within the allowable tolerance of Method 320 (70% to 130%). A summary of all spiking procedures/results can be found in Appendix B.

APPENDIX A

XTO Energy, Inc.
RBU 11-18F #1

Run 1

Record	FTIR Measurements				Date	Time
	NOx Dry	CO ppm Dry	Formaldehyde 191C Wet	H2O% (High) 191C		
1	58.818526	6.751365	15.849054	9.567712	9/18/2013	9:48:50
2	57.3606	6.609528	17.742905	10.723929	9/18/2013	9:49:50
3	56.904073	6.721841	17.226335	10.850119	9/18/2013	9:50:50
4	60.439447	6.772561	16.717034	10.298162	9/18/2013	9:51:50
5	57.277022	6.581348	15.337939	10.582487	9/18/2013	9:52:50
6	59.436911	6.503658	18.814262	11.108117	9/18/2013	9:53:50
7	58.962999	6.623811	19.901938	12.599547	9/18/2013	9:54:50
8	57.132845	6.576075	18.144866	10.618248	9/18/2013	9:55:50
9	58.84012	6.458038	15.445616	10.337928	9/18/2013	9:56:51
10	57.687173	6.457702	16.045384	10.495926	9/18/2013	9:57:51
11	58.143102	6.497866	19.396011	11.321144	9/18/2013	9:58:51
12	57.16164	6.436152	18.23274	11.431107	9/18/2013	9:59:51
13	57.117301	6.323253	18.025207	10.699285	9/18/2013	10:00:51
14	56.341814	6.410634	16.05182	10.393045	9/18/2013	10:01:51
15	57.048605	6.346112	16.10215	10.459393	9/18/2013	10:02:51
16	58.116555	6.255384	16.34672	10.501499	9/18/2013	10:03:51
17	58.713486	6.022218	15.871714	10.59087	9/18/2013	10:04:51
18	60.393677	6.730973	16.895447	10.585998	9/18/2013	10:05:52
19	61.199618	6.713987	16.473158	10.578939	9/18/2013	10:06:52
20	61.210663	6.488434	17.417588	10.968223	9/18/2013	10:07:52
21	60.385005	6.335811	16.948808	10.748001	9/18/2013	10:08:52
22	58.970235	6.466924	17.63248	10.704791	9/18/2013	10:09:52
23	57.287399	6.455545	19.459922	10.92336	9/18/2013	10:10:52
24	57.151021	6.59969	19.523676	10.849135	9/18/2013	10:11:52
25	56.96354	6.469217	16.912033	10.772319	9/18/2013	10:12:52
26	58.227437	6.55644	16.844376	10.604113	9/18/2013	10:13:52
27	60.634943	6.73778	17.055628	10.497381	9/18/2013	10:14:52
28	59.294779	6.810024	17.551749	10.594268	9/18/2013	10:15:53
29	58.734517	6.457427	17.015499	10.784383	9/18/2013	10:16:53
30	58.676285	6.269401	16.958608	10.831524	9/18/2013	10:17:53
31	58.604922	6.484075	17.751103	10.954622	9/18/2013	10:18:53
32	56.851824	6.596929	18.655618	10.863211	9/18/2013	10:19:53
33	58.984849	6.57411	20.004508	10.675395	9/18/2013	10:20:53
34	57.74987	6.659755	18.374074	10.28129	9/18/2013	10:21:53
35	57.855937	6.910333	17.11137	10.228157	9/18/2013	10:22:53
36	55.928871	7.097827	16.159404	9.94496	9/18/2013	10:23:53
37	56.012742	7.112066	16.146313	10.069253	9/18/2013	10:24:53
38	57.483936	6.987564	16.134526	10.211693	9/18/2013	10:25:54
39	57.083228	7.104697	23.807478	11.298367	9/18/2013	10:26:54
40	57.717811	6.711794	19.615002	10.211181	9/18/2013	10:27:54
41	58.060178	7.146456	15.87197	9.668907	9/18/2013	10:28:54
42	58.191994	7.00354	15.27646	9.744402	9/18/2013	10:29:54
43	59.557013	6.945202	15.392708	9.759848	9/18/2013	10:30:54
44	60.869895	6.6424	20.726895	10.500637	9/18/2013	10:31:54
45	59.774089	6.443375	19.227947	10.751726	9/18/2013	10:32:54
46	59.227686	6.468707	14.567377	9.572576	9/18/2013	10:33:54
47	58.59906	6.601625	17.255928	10.47837	9/18/2013	10:34:54
48	59.150758	6.603229	16.068579	9.984024	9/18/2013	10:35:54
49	57.992818	6.551658	17.359198	9.615217	9/18/2013	10:36:54
50	57.972024	6.467138	15.142884	9.869625	9/18/2013	10:37:55
51	58.356877	6.381274	15.611376	9.583841	9/18/2013	10:38:55
52	58.018663	6.404646	19.621835	10.427606	9/18/2013	10:39:55
53	57.230188	6.131762	15.231145	9.428526	9/18/2013	10:40:55
54	58.379752	6.142293	15.954698	9.749753	9/18/2013	10:41:55
55	59.291598	6.097002	15.585296	9.991718	9/18/2013	10:42:55
56	59.823279	6.15947	16.249172	9.863841	9/18/2013	10:43:55
57	59.715406	6.105793	16.504044	9.988772	9/18/2013	10:44:55
58	59.617183	6.60075	15.374457	9.77966	9/18/2013	10:45:55
59	59.556156	6.38265	16.045146	9.338821	9/18/2013	10:46:55
60	60.007915	6.145938	18.230533	10.360513	9/18/2013	10:47:56
AVG	58.47	6.55	17.22	10.42		

Calculated Emission Levels					
NOx (gr/BHp-hr)	NOx (lbs/hr)	CO (gr/BHp-hr)	CO (lbs/hr)	HCOH Dry (ppm)	HCOH @ 15% O2 (ppm)
0.58	1.48	0.04	0.10	19.22	12.06

XTO Energy, Inc.						
RBU 11-18F #1						
Run 2						
Record	FTIR Measurements				Date	Time
	NOx Dry	CO ppm Dry	Formaldehyde 191C Wet	H2O% (High) 191C		
1	60.032944	6.141865	14.296292	6.116139	9/18/2013	10:56:52
2	59.512682	6.131481	13.610021	6.110125	9/18/2013	10:57:52
3	60.172046	6.29443	15.122056	7.518693	9/18/2013	10:58:52
4	59.492213	6.491855	15.696506	8.464525	9/18/2013	10:59:53
5	61.508728	6.433336	14.149658	8.152629	9/18/2013	11:00:53
6	60.647404	6.639613	14.562077	9.058828	9/18/2013	11:01:53
7	62.447525	6.662732	14.179757	8.86265	9/18/2013	11:02:53
8	61.092526	6.592418	16.398682	10.04834	9/18/2013	11:03:53
9	59.442667	6.567346	15.996774	10.027738	9/18/2013	11:04:53
10	58.93022	6.78027	16.247626	9.965288	9/18/2013	11:05:53
11	60.215448	6.458927	16.738515	10.300215	9/18/2013	11:06:53
12	60.29349	6.970335	17.946969	9.923229	9/18/2013	11:07:53
13	60.554023	6.910196	16.84937	10.224249	9/18/2013	11:08:53
14	60.223947	6.37989	17.217496	10.547177	9/18/2013	11:09:54
15	58.542725	6.378238	16.552496	9.369832	9/18/2013	11:10:54
16	59.095914	6.264624	15.93147	9.379653	9/18/2013	11:11:54
17	60.49714	6.668539	15.806397	9.120094	9/18/2013	11:12:54
18	58.389109	6.143563	15.466893	9.711684	9/18/2013	11:13:54
19	57.235249	6.289431	15.233459	9.261441	9/18/2013	11:14:54
20	61.42303	6.027718	15.441321	9.806822	9/18/2013	11:15:54
21	58.632084	5.922322	15.642299	9.532726	9/18/2013	11:16:54
22	58.995129	5.9123	16.783135	9.849485	9/18/2013	11:17:54
23	58.293071	5.912688	17.662088	10.292965	9/18/2013	11:18:54
24	60.319316	5.983275	16.203992	10.087348	9/18/2013	11:19:55
25	61.768253	6.035382	17.25113	9.648397	9/18/2013	11:20:55
26	60.338577	6.170622	15.291464	9.810896	9/18/2013	11:21:55
27	62.200472	6.094455	14.925232	9.576522	9/18/2013	11:22:55
28	58.076722	6.330403	15.551936	9.880226	9/18/2013	11:23:55
29	60.212667	6.17775	16.237705	10.09908	9/18/2013	11:24:55
30	60.638011	6.474621	17.1364	9.842308	9/18/2013	11:25:55
31	61.13468	6.41417	16.619742	9.941752	9/18/2013	11:26:55
32	61.236308	6.889795	15.859868	9.764943	9/18/2013	11:27:55
33	61.973672	7.167339	16.592664	10.003892	9/18/2013	11:28:56
34	60.175959	6.805686	16.580023	9.680584	9/18/2013	11:29:56
35	60.905606	7.442487	17.725027	10.298065	9/18/2013	11:30:56
36	61.439829	6.993571	18.402574	10.495338	9/18/2013	11:31:56
37	61.930464	7.232271	20.331986	10.75755	9/18/2013	11:32:56
38	62.984741	7.379767	17.237719	10.021568	9/18/2013	11:33:56
39	59.122859	7.397369	17.140359	9.83563	9/18/2013	11:34:56
40	60.251126	7.723514	18.101396	10.106799	9/18/2013	11:35:56
41	58.922667	7.754028	17.744714	10.453872	9/18/2013	11:36:56
42	59.340837	8.475741	16.920502	9.661481	9/18/2013	11:37:56
43	59.169873	8.018382	16.30736	9.348965	9/18/2013	11:38:57
44	57.382643	8.155531	16.793176	9.514688	9/18/2013	11:39:57
45	61.711053	8.168248	15.78882	8.744426	9/18/2013	11:40:57
46	59.857464	8.148819	15.892763	8.991003	9/18/2013	11:41:57
47	60.007914	7.801263	15.602075	8.995325	9/18/2013	11:42:57
48	60.831571	7.777688	16.291941	9.407021	9/18/2013	11:43:57
49	59.845743	7.858076	16.920799	9.653626	9/18/2013	11:44:57
50	58.587776	7.739666	17.050444	9.707138	9/18/2013	11:45:57
51	57.08277	7.601103	16.686411	9.58247	9/18/2013	11:46:57
52	58.705118	7.499022	16.355705	9.423528	9/18/2013	11:47:57
53	58.471554	7.240394	17.081076	9.915193	9/18/2013	11:48:58
54	58.927818	7.065444	18.218549	10.572845	9/18/2013	11:49:58
55	59.808269	7.058029	17.433261	9.908969	9/18/2013	11:50:58
56	59.638563	7.275903	19.677467	10.751086	9/18/2013	11:51:58
57	59.500696	7.510102	22.38796	10.95808	9/18/2013	11:52:58
58	58.402658	7.09798	17.008997	9.660523	9/18/2013	11:53:58
59	60.89303	6.863926	15.740749	9.59297	9/18/2013	11:54:58
60	58.887144	6.879487	15.084339	9.181671	9/18/2013	11:55:58
AVG	59.94	6.89	16.53	9.59		

Calculated Emission Levels					
NOx (gr/BHp-hr)	NOx (lbs/hr)	CO (gr/BHp-hr)	CO (lbs/hr)	HCOH Dry (ppm)	HCOH @ 15% O2 (ppm)
0.59	1.59	0.04	0.11	18.28	11.47

XTO Energy, Inc.

RBU 11-18F #1

Run 3

Record	FTIR Measurements				Date	Time
	NOx Dry	CO ppm Dry	Formaldehyde 191C Wet	H2O% (High) 191C		
1	58.804717	6.471877	14.674598	6.75713	9/18/2013	12:06:43
2	58.60128	6.723573	15.951896	7.847987	9/18/2013	12:07:44
3	60.019827	6.465979	17.065606	8.626476	9/18/2013	12:08:44
4	59.186717	6.299405	15.092517	7.905091	9/18/2013	12:09:44
5	58.176419	6.422369	15.005271	7.965084	9/18/2013	12:10:44
6	58.873513	6.241236	13.590824	7.303575	9/18/2013	12:11:44
7	60.793785	6.231908	16.836804	9.645896	9/18/2013	12:12:44
8	58.080513	6.509386	17.99268	10.565608	9/18/2013	12:13:44
9	59.064109	6.478114	17.749489	10.645866	9/18/2013	12:14:44
10	59.481307	6.369114	16.790177	10.374278	9/18/2013	12:15:44
11	59.490496	6.497984	16.616536	10.467328	9/18/2013	12:16:44
12	59.689343	6.64012	17.739851	11.322148	9/18/2013	12:17:45
13	60.641451	6.55685	16.930804	10.522533	9/18/2013	12:18:45
14	59.826698	6.817317	16.72411	10.533276	9/18/2013	12:19:45
15	59.777679	7.011782	16.773392	10.142669	9/18/2013	12:20:45
16	60.348055	6.965868	15.961154	9.72688	9/18/2013	12:21:45
17	60.036884	7.131771	17.302737	10.695284	9/18/2013	12:22:45
18	57.532635	7.221736	17.270837	10.32868	9/18/2013	12:23:45
19	59.911143	7.597109	18.465592	11.07734	9/18/2013	12:24:45
20	61.666449	7.771499	17.971068	9.86396	9/18/2013	12:25:45
21	58.877994	7.556916	17.832623	10.195223	9/18/2013	12:26:45
22	61.250636	7.381197	17.981166	10.717536	9/18/2013	12:27:46
23	59.976865	7.326825	17.902433	10.567597	9/18/2013	12:28:46
24	59.7816	7.413285	16.245228	9.829085	9/18/2013	12:29:46
25	61.146901	8.119458	17.77659	10.762228	9/18/2013	12:30:46
26	60.255899	8.331106	17.500907	9.89878	9/18/2013	12:31:46
27	59.876165	7.954212	16.754667	9.715215	9/18/2013	12:32:46
28	62.241512	8.357023	18.543864	10.361565	9/18/2013	12:33:46
29	57.632311	8.098384	17.359167	10.030593	9/18/2013	12:34:46
30	58.410855	8.164956	19.076366	10.965642	9/18/2013	12:35:46
31	59.130574	8.097758	17.891406	10.231874	9/18/2013	12:36:46
32	57.40662	8.19116	18.311797	10.469791	9/18/2013	12:37:46
33	59.220557	8.604496	19.270018	10.579885	9/18/2013	12:38:47
34	59.643973	8.121401	17.944449	9.875855	9/18/2013	12:39:47
35	57.321568	8.186895	16.681924	10.118778	9/18/2013	12:40:47
36	58.450163	8.019534	15.851894	9.669336	9/18/2013	12:41:47
37	60.671798	8.482333	17.773317	10.337349	9/18/2013	12:42:47
38	58.857426	7.970321	16.715839	9.658853	9/18/2013	12:43:47
39	59.629001	8.067691	18.162514	10.666063	9/18/2013	12:44:47
40	60.770718	8.999697	17.369954	9.709908	9/18/2013	12:45:47
41	63.207231	8.523015	18.266941	10.177373	9/18/2013	12:46:47
42	59.036042	8.468707	18.640987	10.597369	9/18/2013	12:47:48
43	58.021043	8.539844	17.238205	9.717649	9/18/2013	12:48:48
44	58.978994	8.733648	18.593202	10.141016	9/18/2013	12:49:48
45	57.618308	8.940211	19.653213	10.159614	9/18/2013	12:50:48
46	58.005897	9.277369	19.075062	10.101699	9/18/2013	12:51:48
47	55.847523	10.209897	18.779052	10.247986	9/18/2013	12:52:48
48	57.68584	10.196347	18.622427	10.063837	9/18/2013	12:53:48
49	57.872611	9.774455	19.308549	10.238874	9/18/2013	12:54:48
50	56.663339	9.979629	19.191604	9.584801	9/18/2013	12:55:48
51	57.240679	9.98101	18.563414	10.071637	9/18/2013	12:56:48
52	56.581985	10.122486	19.16566	10.555039	9/18/2013	12:57:49
53	56.746858	10.029364	19.507428	10.462082	9/18/2013	12:58:49
54	58.295928	10.419063	20.105153	10.425027	9/18/2013	12:59:49
55	57.728042	9.677869	21.917914	10.760508	9/18/2013	13:00:49
56	56.954837	9.676457	19.164516	10.463761	9/18/2013	13:01:49
57	58.989825	9.222328	19.455725	10.84869	9/18/2013	13:02:49
58	59.271511	9.30679	19.049317	10.014496	9/18/2013	13:03:49
59	57.605024	8.891692	20.884448	10.743649	9/18/2013	13:04:49
60	57.8547	8.953491	18.390023	10.324751	9/18/2013	13:05:49
AVG	59.01	8.08	17.82	10.04		

Calculated Emission Levels					
NOx (gr/BHp-hr)	NOx (lbs/hr)	CO (gr/BHp-hr)	CO (lbs/hr)	HCOH Dry (ppm)	HCOH @ 15% O2 (ppm)
0.59	1.58	0.05	0.13	19.81	12.56

APPENDIX B

Raw Calibration Data

BACKGROUND

Date	Time	NO 191C span	NO2 191C span	H2O% (high) 191C	Formaldehyde 191C	Ethylene 191C TE span	Propane 191C span	Acetaldehyde 191C span	CO ppm 191C (1of2) span	CO ppm Dry	CO2% 191C	NOx Wet	NOx Dry	NM NE HC C3
9/18/2013	8:58:54	-0.021782	-0.096775	-0.009681	-0.150363	-0.718126	-0.126428	-0.095806	0.254184	0.254159	-0.025756	-0.118556	-0.111061	0.000060
9/18/2013	8:59:02	0.052549	-0.09681	-0.006258	0.081137	-0.365881	-0.2655	-0.289026	-0.085556	-0.085551	-0.014914	-0.013961	-0.01396	0.000060
9/18/2013	8:59:09	0	0	0	0	0	0	0	0	0	0	0	0	0
9/18/2013	9:00:22	-0.013765	-0.043201	-0.007873	-0.085423	0.330794	-0.043724	0.423258	0.19500	0.19500	0.037743	-0.057058	-0.057052	0.041127
9/18/2013	9:00:30	-0.147154	0.019229	-0.00209	0.005527	-0.157687	-0.01307	-0.597498	0.142782	0.142779	0.001916	-0.127925	-0.127922	0.035960
9/18/2013	9:00:37	-0.004498	-0.037288	-0.002091	-0.088708	0.029377	-0.603555	0.981728	-0.041653	-0.041652	-0.012317	-0.041784	-0.041763	0.028774
9/18/2013	9:00:45	0.008027	0.080123	0.000189	-0.045868	0.489741	-0.027828	0.735161	0.024287	0.024287	-0.009822	0.08815	0.08815	0.001135
9/18/2013	9:00:52	0.133318	-0.003724	-0.0006889	-0.019157	0.001325	0.182839	-0.32952	-0.107745	-0.107744	-0.004274	0.129594	0.129593	0.019162
9/18/2013	9:01:00	-0.101524	0.085471	-0.003171	-0.187373	-0.732549	0.004884	0.339545	-0.103183	-0.103183	-0.012452	-0.036053	-0.036052	0.000043
9/18/2013	9:01:07	-0.070962	0.023417	-0.000223	-0.166878	0.542241	0.689825	0.752321	0.151722	0.151722	-0.007242	-0.047275	-0.047275	0.105983
9/18/2013	9:01:15	-0.069498	0.049503	-0.004228	-0.014534	0.304352	0.75833	0.384153	0.0305	0.0303	-0.007438	-0.013863	-0.013862	0.172677
9/18/2013	9:01:22	-0.148848	-0.030311	-0.003143	-0.110907	0.130904	-0.409852	0.367395	0.022873	0.022873	-0.009985	-0.179159	-0.179157	0.033825
9/18/2013	9:01:30	-0.007751	-0.044382	-0.002149	-0.0975	-0.138864	-0.327411	-0.103242	-0.107812	-0.107812	-0.01337	-0.052133	-0.052132	0.000000

PRE DIRECT CAL

Date	Time	CO ppm 191C (1of2) span	NOx Wet	Propane 191C span	Date	Time	Ethylene 191C TE	Date	Time	Acetaldehyde 191C span
9/18/2013	9:01:37	123.105384	126.356956	120.417782	9/18/2013	9:05:48	0.193746	9/19/2013	9:03:07	-0.024943
9/18/2013	9:01:45	350.916537	351.554842	345.857767	9/18/2013	9:05:55	-1.306125	9/18/2013	9:03:15	1.527261
9/18/2013	9:01:53	480.862691	484.098064	480.081383	9/18/2013	9:06:03	8.484959	9/18/2013	9:03:22	18.275259
9/18/2013	9:02:00	489.151986	492.326959	485.915198	9/18/2013	9:06:10	58.473597	9/18/2013	9:03:30	23.880568
9/18/2013	9:02:08	495.151986	499.326909	497.427474	9/18/2013	9:06:18	87.100992	9/18/2013	9:03:37	24.937279
9/18/2013	9:02:15	497.344156	500.602403	501.148255	9/18/2013	9:06:25	85.47518	9/18/2013	9:03:45	24.521435
9/18/2013	9:02:23	497.833781	500.137328	496.075441	9/18/2013	9:06:33	97.758278	9/18/2013	9:03:52	26.377893
9/18/2013	9:02:30	498.347907	500.8273	498.833817	9/18/2013	9:06:40	97.950129	9/18/2013	9:06:48	97.900588
					9/18/2013	9:06:48	98.905688	9/18/2013	9:06:55	98.92647

PRE SYSTEM CAL

Date	Time	CO ppm 191C (1of2) span	NOx Wet	Propane 191C span	Date	Time	Ethylene 191C TE	Date	Time	Acetaldehyde 191C span
9/18/2013	9:22:48	7.668943	50.231877	34.100402	9/19/2013	9:28:09	16.208856	9/18/2013	9:23:49	3.989526
9/18/2013	9:22:56	18.798648	57.147072	42.744809	9/18/2013	9:28:17	88.405369	9/18/2013	9:23:56	11.769076
9/18/2013	9:23:03	352.560685	362.35522	350.361102	9/18/2013	9:28:24	99.828913	9/18/2013	9:24:04	16.888098
9/18/2013	9:23:11	482.859138	484.985056	482.157535	9/18/2013	9:28:31	97.950129	9/18/2013	9:24:21	19.323554
9/18/2013	9:23:18	494.352296	495.300412	493.003366	9/18/2013	9:28:38	97.900588	9/18/2013	9:24:28	19.730373
					9/18/2013	9:28:44	20.714611	9/18/2013	9:24:41	20.783779
					9/18/2013	9:28:49	21.370782	9/18/2013	9:24:56	22.353434
					9/18/2013	9:29:04	21.64571	9/18/2013	9:25:04	22.370798
					9/18/2013	9:29:11	22.370798	9/18/2013	9:25:28	22.987856
					9/18/2013	9:29:25	23.018611	9/18/2013	9:25:34	23.62947
					9/18/2013	9:29:41	23.446007	9/18/2013	9:25:49	23.884401
					9/18/2013	9:29:48	23.884401	9/18/2013	9:26:56	22.833853
					9/18/2013	9:29:54	23.708491	9/18/2013	9:26:04	23.323798
					9/18/2013	9:29:58	23.603512	9/18/2013	9:26:49	23.279891
					9/18/2013	9:29:57	23.784192	9/18/2013	9:27:04	24.131086
					9/18/2013	9:27:12	23.662915	9/18/2013	9:27:19	24.262283
					9/18/2013	9:27:27	22.804663	9/18/2013	9:27:34	24.93309

NO2 CAL

Date	Time	NO2 191C span
9/18/2013	9:04:26	-0.034193
9/18/2013	9:04:34	38.494927
9/18/2013	9:04:41	139.370233
9/18/2013	9:04:49	145.977251
9/18/2013	9:04:56	147.132448
9/18/2013	9:05:04	147.451017
9/18/2013	9:05:11	147.797777

SAMPLE SPIKE RECOVERY

Date	Time	CO2% 191C	CO ppm 191C (10f2) span	NO 191C span	Propane 191C span
9/18/2013	9:43:24	5.074581	5.650000	52.397577	33.22512
9/18/2013	9:44:01	5.0987	5.981770	51.830959	32.55818
9/18/2013	9:44:09	5.092198	5.981105	51.524725	32.558428
9/18/2013	9:44:18	5.044052	5.533227	52.872694	32.38008
9/18/2013	9:44:24	3.401365	27.505332	83.194811	47.851138
9/18/2013	9:44:31	0.442702	358.402945	359.863051	353.130587
9/18/2013	9:44:39	0.056233	446.151879	443.903591	448.377065
9/18/2013	9:44:46	0.887587	365.737919	375.278643	362.525585
9/18/2013	9:44:54	3.917111	108.019152	142.537559	129.585758
9/18/2013	9:45:01	4.389184	65.011956	103.253661	89.840016
9/18/2013	9:45:09	4.474334	81.111019	99.029030	85.254723
9/18/2013	9:45:18	4.4982	59.931670	89.029033	83.30000
9/18/2013	9:45:24	4.5276	59.821927	89.837833	85.767732
9/18/2013	9:45:31	4.546471	60.107817	99.213867	85.039873
9/18/2013	9:45:39	4.576634	60.558025	100.237511	84.371778
9/18/2013	9:45:46	4.552671	59.039795	98.210064	84.485172
9/18/2013	9:45:54	4.623899	55.68206	98.445671	80.85398
9/18/2013	9:46:16	4.817193	50.99989	78.00997	75.151337
9/18/2013	9:46:39	4.811629	47.229315	80.820311	74.418612
9/18/2013	9:47:09	4.843496	47.75864	89.405295	71.822252
9/18/2013	9:47:17	4.540947	48.90004	93.192905	74.968852

ACETALDEHYDE SPIKE RECOVERY

Date	Time	CO2% 191C	Acetaldehyde 191C span
9/18/2013	9:37:07	5.003021	3.48678
9/18/2013	9:37:27	5.058308	4.49559
9/18/2013	9:37:34	5.033199	2.788183
9/18/2013	9:38:04	5.041773	1.237391
9/18/2013	9:38:12	5.070258	2.8995175
9/18/2013	9:38:20	5.029783	1.883175
9/18/2013	9:38:27	1.424308	3.463961
9/18/2013	9:38:34	0.098224	19.016532
9/18/2013	9:38:42	0.034051	21.938432
9/18/2013	9:38:49	0.02487	23.550201
9/18/2013	9:38:57	0.014101	23.765608
9/18/2013	9:39:04	0.028447	23.190047
9/18/2013	9:39:12	0.01879	22.409531
9/18/2013	9:39:19	2.547714	18.70954
9/18/2013	9:39:27	4.575821	7.690272
9/18/2013	9:39:34	4.77056	5.303985
9/18/2013	9:39:42	4.787119	6.183707
9/18/2013	9:39:49	4.842935	4.471136
9/18/2013	9:39:57	4.814162	5.486774
9/18/2013	9:40:04	4.827408	5.356025
9/18/2013	9:40:12	4.747383	5.161265
9/18/2013	9:40:19	4.717692	5.505069
9/18/2013	9:40:27	4.705981	4.495647
9/18/2013	9:40:35	4.707449	5.430206
9/18/2013	9:40:42	4.586277	6.439877
9/18/2013	9:40:49	4.523134	6.773185
9/18/2013	9:41:05	4.561581	6.415988
9/18/2013	9:41:12	4.535213	7.017845
9/18/2013	9:41:20	4.538633	5.698504
9/18/2013	9:41:57	4.651021	4.127285

POST DIRECT CAL

Date	Time	CO ppm 191C (10f2) span	NOx Wet	Propane 191C span	Date	Time	Acetaldehyde 191C span
9/18/2013	13:22:35	0.198677	0.183352	-0.977095	9/18/2013	13:25:08	1.173308
9/18/2013	13:23:43	0.907947	1.317439	0.446881	9/18/2013	13:25:15	1.79807
9/18/2013	13:23:50	104.232421	106.733784	102.689277	9/18/2013	13:25:23	2.571799
9/18/2013	13:23:58	336.564727	337.519248	331.887473	9/18/2013	13:25:30	21.96211
9/18/2013	13:24:05	451.736143	454.31769	448.746554	9/18/2013	13:25:38	25.982407
9/18/2013	13:24:13	488.593485	489.568206	484.567212			
9/18/2013	13:24:20	498.256578	499.829516	493.471496			
9/18/2013	13:24:28	500.895975	502.860355	498.113586			

POST SYSTEM CAL

Date	Time	Ethylene 191C TE
9/18/2013	13:14:11	17.205341
9/18/2013	13:14:18	17.34069
9/18/2013	13:14:26	17.327311
9/18/2013	13:14:33	02.159905
9/18/2013	13:14:41	87.591331
9/18/2013	13:14:48	91.993471
9/18/2013	13:14:56	92.416678
9/18/2013	13:15:04	92.210192
9/18/2013	13:15:11	93.297861
9/18/2013	13:15:19	93.058287
9/18/2013	13:15:26	93.056673
9/18/2013	13:15:34	93.107581
9/18/2013	13:15:41	93.967448
9/18/2013	13:15:48	94.029792
9/18/2013	13:15:56	93.091715
9/18/2013	13:16:04	94.216795

FTIR QA/QC SUMMARY

SAMPLE RECOVERY CALCULATIONS																
Period	Spike #	Concentration of CO Cylinder	Concentration of Propane Cylinder	Concentration of NO Cylinder	Stack CO2 Concentration	Stack CO Concentration	Stack NO Concentration	Stack Propane Concentration	Stack + Spike CO2 Concentration	Stack + CO Concentration	Stack + NO Concentration	Stack + Propane Concentration	DF Calculated	% Recovery CO	% Recovery NO	% Recovery Propane
PRE TEST	1	498.8	502.0	507.0	5.1	5.8	51.5	32.6	4.6	47.8	89.4	71.8	0.088	96.6%	95.0%	95.3%

ACETALDEHYDE SAMPLE RECOVERY CALCULATIONS								
Period	Spike #	Concentration of CH3CHO Cylinder	Stack CO2 Concentration	Stack CH3CHO Concentration	Stack + Spike CO2 Concentration	DF Calculated	% Recovery CH3CHO	
PRE TEST	1	26.0	5.0	2.8	4.5	5.7	0.098	124.3%

PRE SYSTEM CAL			
Sensor	System Response (ppm)	Cal Level (ppm)	Cal Recovery (%)
NOx	495.3	507.0	-2.3
CO	494.4	498.8	-0.9
Propane	493.0	502.0	-1.8
*Ethylene	99.8	99.0	0.8
Acetaldehyde	24.9	26.0	-4.1

PRE DIRECT CAL				
Sensor	Analyzer Response (ppm)	Cal Level (ppm)	Zero Response (ppm)	Cal Error (%)
				Zero Error (%)
NOx	500.8	507.0	0.4	-1.2
CO	498.3	498.8	-0.1	-0.1
Propane	498.8	502.0	0.4	-0.6
Ethylene	98.9	99.0	-0.4	-0.1
Acetaldehyde	26.0	26.0	-0.4	-0.05
				-1.6

POST DIRECT CAL					
Sensor	Analyzer Response (ppm)	Cal Level (ppm)	Zero Response (ppm)	Cal Error (%)	Zero Error (%)
NOx	502.9	507.0	0.3	-0.8	0.1
CO	500.7	498.8	0.1	0.4	0.02
Propane	498.1	502.0	0.4	-0.8	0.1
Acetaldehyde	26.0	26.0	0.4	-0.03	1.6

POST SYSTEM CAL			
Sensor	System Response (ppm)	Cal Level (ppm)	Cal Recovery (%)
*Ethylene	94.2	99.0	-4.8

*CTS Scans are conducted with Ethylene through the sample line.

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E05NI99E15A0000
 Cylinder Number: CC73582
 Laboratory: ASG - Chicago - IL
 PGVP Number: B12013
 Gas Code: CH4,CO,NO,PPN,BALN
 Reference Number: 54-124366204-1
 Cylinder Volume: 144.4 CF
 Cylinder Pressure: 2015 PSIG
 Valve Outlet: 660
 Certification Date: Apr 02, 2013

Expiration Date: Apr 02, 2021

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	500.0 PPM	507.1 PPM	G1	+/- 1.0% NIST Traceable	03/26/2013, 04/02/2013
CARBON MONOXIDE	500.0 PPM	498.8 PPM	G1	+/- 0.9% NIST Traceable	03/26/2013
METHANE	500.0 PPM	505.1 PPM	G1	+/- 0.7% NIST Traceable	03/27/2013
NITRIC OXIDE	500.0 PPM	507.1 PPM	G1	+/- 1.0% NIST Traceable	03/26/2013, 04/02/2013
PROPANE	500.0 PPM	502.0 PPM	G1	+/- 1% NIST Traceable	03/27/2013
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	12062429	CC366885	487.1 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 22, 2018
NTRM/CH4	10060916	CC321243	500.5 PPM METHANE/NITROGEN	+/- 0.6%	Aug 07, 2016
NTRM/NO	12061034	CC359504	500.7 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	Feb 16, 2018
NO2	124206889130	CC323209	4.824 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Oct 25, 2015
NTRM	10060514	CC281296	495.3 PPM PROPANE/AIR	+/- 0.5%	Feb 19, 2016

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nexus 470 AEP0000428	FTIR	Mar 04, 2013
Nicolet 6700 AHR0801332	FTIR	Feb 27, 2013
Nexus 470 AEP0000428	FTIR	Mar 04, 2013
Nexus 470 AEP0000428	FTIR	Mar 04, 2013
(V-1) VARIAN CP3800 FID	FID	Mar 25, 2013

Triad Data Available Upon Request

Notes:

CERTIFICATE OF ANALYSIS Grade of Product: EPA Protocol

Part Number: E03NI99E15A2059 Reference Number: 54-124280274-3
Cylinder Number: CC71055 Cylinder Volume: 144 Cu.Ft.
Laboratory: ASG - Chicago - IL Cylinder Pressure: 2015 PSIG
PGVP Number: B12011 Valve Outlet: 660
Gas Code: NO2 Analysis Date: Sep 12, 2011

Expiration Date: Sep 12, 2013

Certification performed in accordance with "EPA Traceability Protocol (Sept. 1997)" using the assay procedures listed. Analytical Methodology does not require correction for analytical interferences. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.
Do Not Use This Cylinder below 150 psig.i.e. 1 Mega Paas!

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	
NITROGEN DIOXIDE	150.0 PPM	150.4 PPM	G1	+/-1% NIST Traceable	
NITROGEN	Balance				
CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Expiration Date	
GMIS/NO2	124083511207	CC208246	245.4PPM NITROGEN DIOXIDE/NITROGEN	Nov 25, 2011	
ANALYTICAL EQUIPMENT					
Instrument/Make/Model	Analytical Principle			Last Multipoint Calibration	
(FTIR-2)Nicolet Magna	FTIR			Aug 26, 2011	

Triad Data Available Upon Request

Notes:

Approved for Release

CERTIFICATE OF ANALYSIS

Grade of Product: PRIMARY STANDARD

Airgas Specialty Gases

12722 South Wentworth Avenue
Chicago, IL 60628
(773) 785-3000 Fax: (773) 785-1928
www.airgas.com

Part Number: X02NI99P15AD524 Reference Number: 54-124315088-3
Cylinder Number: CC48271 Cylinder Volume: 144.4 CF
Laboratory: ASG - Chicago - IL Cylinder Pressure: 2015 PSIG
Analysis Date: May 04, 2012 Valve Outlet: 350

Product directly traceable to NIST ASTM Class 1 weights and/or NIST gas mixture reference materials.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration (Mole %)	Analytical Uncertainty
ETHYLENE	100.0 PPM	99.13 PPM	+/- 1%
NITROGEN	Balance		

Notes:

Approved for Release

AIRGAS**CERTIFICATE OF ANALYSIS**

Airgas Specialty Gases
1075 Circular Drive
225.388.0900
www.airgas.com

Cylinder Number: 399100379DAL Serial #: 00-124323665-1
Laboratory: ASG Port Allen, LA Cylinder Volume: 144.4 CF
Analysis Date: Jul 18, 2012 Cylinder Pressure: 2015 PSIG
 Valve Outlet: 350

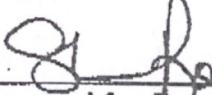
Expiration Date: Jul 18, 2013

Product composition verified by direct comparison to calibration standards traceable to NIST ASTM Class 1 weights and/or NIST gas mixture reference materials.

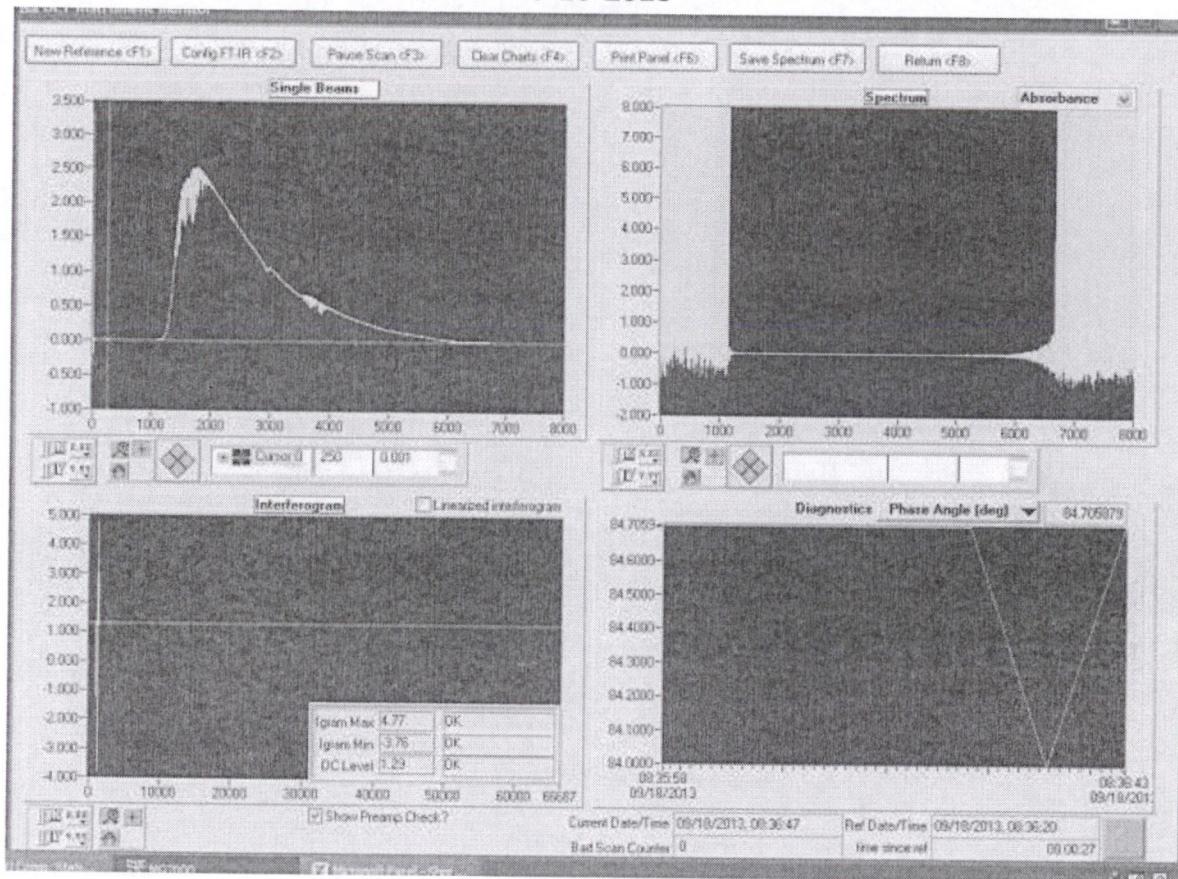
ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration (Mole %)	Analytical Uncertainty
ACETALDEHYDE	30.00 PPM	25.99 PPM	+/- 5%
NITROGEN	Balance		

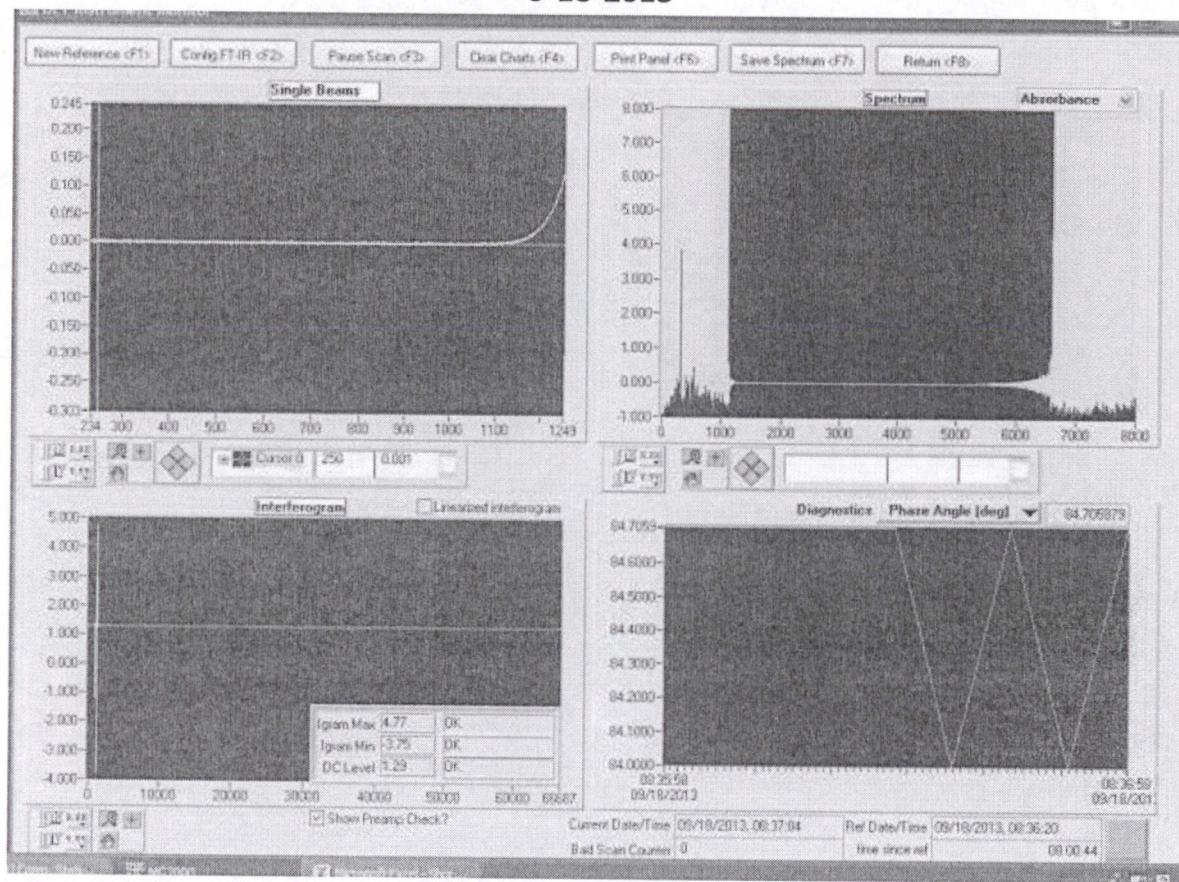
Notes:


Approved for Release

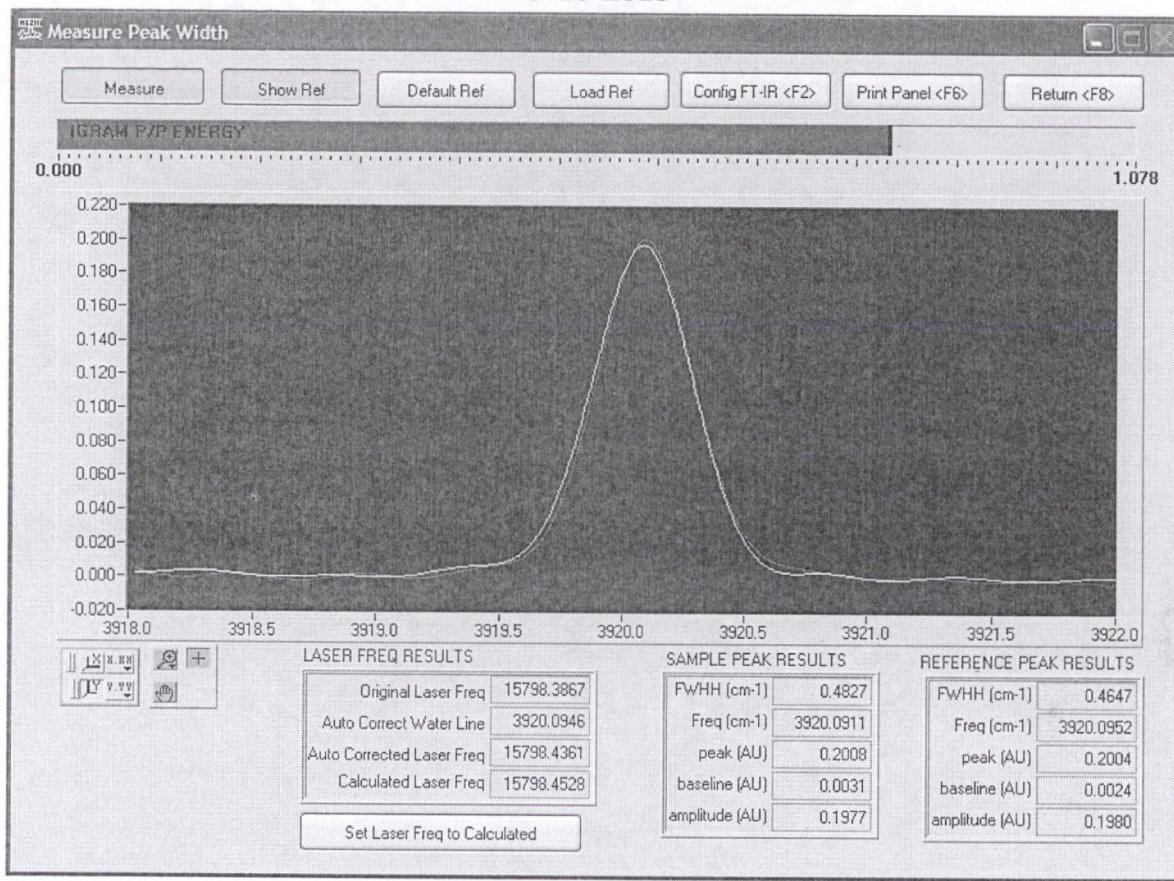
XTO – RBU 11-18F Facility
9-18-2013



XTO – RBU 11-18F Facility
9-18-2013



XTO – RBU 11-18F Facility
9-18-2013



Instrument Resolution – FWHH – 0.4827 cm⁻¹ which is < 0.55 cm⁻¹ (therefore meets ASTM)
Water Frequency – Freq – 3920.0911 cm⁻¹ which is +/- 0.075 of 3920.0952 cm⁻¹ (therefore meets ASTM)

Please note: FWHH is the Full Width at Half Height of the resolution. The frequency position is only calculating the center line for one water line in the spectrum. MKS uses 3920.0952 cm⁻¹ since it is a single water line.

CO/NO/NO₂/Formaldehyde FTIR Instrument Noise-Limited Minimum Detectable Concentration - MDC#2

Noise Equivalent Absorbance Data				
Spectrum	CO	NO	NO ₂	Formaldehyde
XTO RBU 11-18 F 9-18-13_000004.LAB	0.16	-0.01	-0.04	-0.09
XTO RBU 11-18 F 9-18-13_000005.LAB	0.14	-0.15	0.02	0.01
XTO RBU 11-18 F 9-18-13_000006.LAB	-0.04	0.00	-0.04	-0.09
XTO RBU 11-18 F 9-18-13_000007.LAB	0.02	0.01	0.08	-0.05
XTO RBU 11-18 F 9-18-13_000008.LAB	-0.11	0.13	0.00	-0.02
XTO RBU 11-18 F 9-18-13_000009.LAB	-0.10	-0.10	0.07	-0.19
XTO RBU 11-18 F 9-18-13_000010.LAB	0.15	-0.07	0.02	-0.17
XTO RBU 11-18 F 9-18-13_000011.LAB	0.00	-0.06	0.05	-0.01
XTO RBU 11-18 F 9-18-13_000012.LAB	0.02	-0.15	-0.03	-0.11
XTO RBU 11-18 F 9-18-13_000013.LAB	-0.11	-0.01	-0.04	-0.10
Noise Equivalent Absorbance (Standard Deviation)	0.10	0.08	0.04	0.06
MDC #2	0.31	0.24	0.13	0.18

APPENDIX C

G3606

GAS COMPRESSION APPLICATION

GAS ENGINE SITE SPECIFIC TECHNICAL DATA XTO - RBU 11-18F #1



ENGINE SPEED (rpm):	985
COMPRESSION RATIO:	9.2:1
AFTERCooler TYPE:	SCAC
AFTERCooler WATER INLET (°F):	130
JACKET WATER OUTLET (°F):	190
ASPIRATION:	TA
COOLING SYSTEM:	JW, OC+AC
CONTROL SYSTEM:	CIS/ADEM3
EXHAUST MANIFOLD:	DRY
COMBUSTION:	Low Emission
NOx EMISSION LEVEL (g/bhp-hr NOx):	0.7

RATING STRATEGY:	STANDARD
FUEL SYSTEM:	GAV
SITE CONDITIONS:	WITH AIR FUEL RATIO CONTROL
FUEL:	Field Gas
FUEL PRESSURE RANGE(psig):	42.8-47.0
FUEL METHANE NUMBER:	62.2
FUEL LHV (Btu/scf):	1027
ALTITUDE(ft):	5278
MAXIMUM INLET AIR TEMPERATURE(°F):	73
STANDARD RATED POWER:	1775 bhp@1000rpm

RATING	(WITHOUT FAN)	NOTES	LOAD	MAXIMUM RATING		SITE RATING AT MAXIMUM INLET AIR TEMPERATURE		
				100%	100%	75%	52%	
ENGINE POWER		(1)	bhp	1748	1695	1271	888	
INLET AIR TEMPERATURE			°F	40	73	73	73	

ENGINE DATA								
FUEL CONSUMPTION (LHV)		(2)	Btu/bhp-hr	6771	6807	7108	7559	
FUEL CONSUMPTION (HHV)		(2)	Btu/bhp-hr	7482	7521	7854	8353	
AIR FLOW @inlet air temp, 14.7 psia)	(WET)	(3)(4)	f13/min	4182	4339	3369	2374	
AIR FLOW	(WET)	(3)(4)	lb/hr	19922	19382	15052	10606	
FUEL FLOW (60°F, 14.7 psia)		(5)	scfm	192	187	147	109	
INLET MANIFOLD PRESSURE		(6)	in Hg(abs)	72.0	70.1	54.7	40.5	
EXHAUST TEMPERATURE - ENGINE OUTLET		(7)(4)	°F	865	868	894	954	
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(7)(4)	f13/min	11782	11489	9106	6715	
EXHAUST GAS MASS FLOW	(WET)	(7)(4)	lb/hr	20492	19937	15488	10930	

EMISSIONS DATA - ENGINE OUT								
NOx (as NO2)		(8)(9)	g/bhp-hr	0.70	0.70	0.70	0.70	
CO		(8)(9)	g/bhp-hr	2.50	2.50	2.50	2.50	
THC (mol. wt. of 15.84)		(8)(9)	g/bhp-hr	6.22	6.24	6.45	6.68	
NMHC (mol. wt. of 15.84)		(8)(9)	g/bhp-hr	1.61	1.62	1.67	1.73	
NMNEHC (VOCs) (mol. wt. of 15.84)		(8)(9)(10)	g/bhp-hr	1.08	1.09	1.12	1.16	
HCHO (Formaldehyde)		(8)(9)	g/bhp-hr	0.26	0.27	0.28	0.31	
CO2		(8)(9)	g/bhp-hr	439	441	461	491	
EXHAUST OXYGEN		(8)(11)	% DRY	12.6	12.5	11.8	10.9	

HEAT REJECTION								
HEAT REJ. TO JACKET WATER (JW)		(12)	Btu/min	17562	17429	15041	12688	
HEAT REJ. TO ATMOSPHERE		(12)	Btu/min	6906	6894	6505	6106	
HEAT REJ. TO LUBE OIL (OC)		(12)	Btu/min	8879	8888	8559	8318	
HEAT REJ. TO AFTERCOOLER (AC)		(12)(13)	Btu/min	16234	16234	8002	1772	

COOLING SYSTEM SIZING CRITERIA			
TOTAL JACKET WATER CIRCUIT (JW)		(13)	Btu/min
TOTAL AFTERCOOLER CIRCUIT (OC+AC)		(13)(14)	Btu/min

A cooling system safety factor of 0% has been added to the cooling system sizing criteria.

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Max. rating is the maximum capability for the specified fuel at site altitude and reduced inlet air temperature. Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

Run 1 - intake man press -> 25 psi -> 50.90 in Hg

Pabs = 50.90 in Hg

by linear interpolation, est BHP => 1168.5 BHP

G3606

GAS COMPRESSION APPLICATION

GAS ENGINE SITE SPECIFIC TECHNICAL DATA XTO - RBU 11-18F #1



ENGINE SPEED (rpm):	984	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	9.2:1		GAV
AFTERTOOLER TYPE:	SCAC		WITH AIR FUEL RATIO CONTROL
AFTERTOOLER WATER INLET (°F):	130		
JACKET WATER OUTLET (°F):	190		
ASPIRATION:	TA		Field Gas
COOLING SYSTEM:	JW, OC+AC	FUEL PRESSURE RANGE(psig):	42.8-47.0
CONTROL SYSTEM:	CIS/ADEM3	FUEL METHANE NUMBER:	62.2
EXHAUST MANIFOLD:	DRY	FUEL LHV (Btu/scf):	1027
COMBUSTION:	Low Emission	ALTITUDE(ft):	5278
NOx EMISSION LEVEL (g/bhp-hr NOx):	0.7	MAXIMUM INLET AIR TEMPERATURE(°F):	77
		STANDARD RATED POWER:	1775 bhp@1000rpm

RATING	NOTES	LOAD	MAXIMUM	SITE RATING AT MAXIMUM		
			RATING	100%	100%	75%
ENGINE POWER (WITHOUT FAN)	(1)	bhp	1747	1688	1266	888
INLET AIR TEMPERATURE		°F	40	77	77	77

ENGINE DATA						
FUEL CONSUMPTION (LHV)	(2)	Btu/bhp-hr	6771	6810	7112	7558
FUEL CONSUMPTION (HHV)	(2)	Btu/bhp-hr	7481	7524	7859	8351
AIR FLOW (@inlet air temp, 14.7 psia)	(WET)	(3)(4)	ft³/min	4179	4354	3380
AIR FLOW	(WET)	(3)(4)	lb/hr	19903	19307	2392
FUEL FLOW (60°F, 14.7 psia)			scfm	192	186	109
INLET MANIFOLD PRESSURE			in Hg(abs)	72.0	69.9	54.5
EXHAUST TEMPERATURE - ENGINE OUTLET			°F	865	868	954
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(7)(4)	ft³/min	11770	11445	9071
EXHAUST GAS MASS FLOW	(WET)	(7)(4)	lb/hr	20473	19860	15423
						10930

EMISSIONS DATA - ENGINE OUT						
NOx (as NO2)	(8)(9)	g/bhp-hr	0.70	0.70	0.70	0.70
CO	(8)(9)	g/bhp-hr	2.50	2.49	2.50	2.50
THC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	6.24	6.26	6.47	6.70
NMHC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	1.62	1.62	1.68	1.74
NMNEHC (VOCs) (mol. wt. of 15.84)	(8)(9)(10)	g/bhp-hr	1.09	1.09	1.13	1.17
HCHO (Formaldehyde)	(8)(9)	g/bhp-hr	0.26	0.27	0.28	0.31
CO2	(8)(9)	g/bhp-hr	439	441	461	490
EXHAUST OXYGEN	(8)(11)	% DRY	12.6	12.5	11.8	10.9

HEAT REJECTION						
HEAT REJ. TO JACKET WATER (JW)	(12)	Btu/min	17532	17383	15007	12676
HEAT REJ. TO ATMOSPHERE	(12)	Btu/min	6898	6885	6499	6101
HEAT REJ. TO LUBE OIL (OC)	(12)	Btu/min	8869	8878	8556	8312
HEAT REJ. TO AFTERCOOLER (AC)	(12)(13)	Btu/min	16688	16688	8134	1829

COOLING SYSTEM SIZING CRITERIA			
TOTAL JACKET WATER CIRCUIT (JW)	(13)	Btu/min	19285
TOTAL AFTERCOOLER CIRCUIT (OC+AC)	(13)(14)	Btu/min	26176

A cooling system safety factor of 0% has been added to the cooling system sizing criteria.

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Max. rating is the maximum capability for the specified fuel at site altitude and reduced inlet air temperature. Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

Run 2 - intake man press -> 26 psi -> 52.94 in Hg
Pabs = 52.94 in Hg

by linear interpolation, est BHP => 1223.9 BHP

G3606

GAS COMPRESSION APPLICATION

GAS ENGINE SITE SPECIFIC TECHNICAL DATA XTO - RBU 11-18F #1



ENGINE SPEED (rpm):	985	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	9.2:1	FUEL SYSTEM:	GAV
AFTERCooler TYPE:	SCAC	SITE CONDITIONS:	WITH AIR FUEL RATIO CONTROL
AFTERCOOLER WATER INLET (°F):	130	FUEL:	Field Gas
JACKET WATER OUTLET (°F):	190	FUEL PRESSURE RANGE(psig):	42.8-47.0
ASPIRATION:	TA	FUEL METHANE NUMBER:	62.2
COOLING SYSTEM:	JW, OC+AC	FUEL LHV (Btu/scf):	1027
CONTROL SYSTEM:	CIS/ADEM3	ALTITUDE(ft):	5278
EXHAUST MANIFOLD:	DRY	MAXIMUM INLET AIR TEMPERATURE(°F):	79
COMBUSTION:	Low Emission	STANDARD RATED POWER:	1775 bhp@1000rpm
NOx EMISSION LEVEL (g/bhp-hr NOx):	0.7		

RATING	NOTES	LOAD	100%	100%	75%	53%
ENGINE POWER (WITHOUT FAN) INLET AIR TEMPERATURE	(1)	bhp °F	1748 40	1686 79	1265 79	888 79

ENGINE DATA						
FUEL CONSUMPTION (LHV)	(2)	Btu/bhp-hr	6771	6812	7116	7559
FUEL CONSUMPTION (HHV)	(2)	Btu/bhp-hr	7482	7527	7863	8353
AIR FLOW (@inlet air temp, 14.7 psia)	(WET)	ft3/min	4182	4367	3390	2401
AIR FLOW	(WET)	lb/hr	19922	19294	14977	10606
FUEL FLOW (60°F, 14.7 psia)		scfm	192	186	146	109
INLET MANIFOLD PRESSURE	(5)	in Hg(abs)	72.0	69.8	54.4	40.5
EXHAUST TEMPERATURE - ENGINE OUTLET	(6)	°F	865	868	895	954
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	ft3/min	11782	11441	9067	6715
EXHAUST GAS MASS FLOW	(WET)	lb/hr	20492	19847	15410	10930

EMISSIONS DATA - ENGINE OUT						
NOx (as NO2)	(8)(9)	g/bhp-hr	0.70	0.70	0.70	0.70
CO	(8)(9)	g/bhp-hr	2.50	2.49	2.50	2.50
THC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	6.22	6.25	6.46	6.68
NMHC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	1.61	1.62	1.67	1.73
NMNEHC (VOCs) (mol. wt. of 15.84)	(8)(9)(10)	g/bhp-hr	1.08	1.09	1.13	1.16
HCHO (Formaldehyde)	(8)(9)	g/bhp-hr	0.26	0.27	0.28	0.31
CO2	(8)(9)	g/bhp-hr	439	442	462	491
EXHAUST OXYGEN	(8)(11)	% DRY	12.6	12.5	11.8	10.9

HEAT REJECTION						
HEAT REJ. TO JACKET WATER (JW)	(12)	Btu/min	17562	17403	15025	12688
HEAT REJ. TO ATMOSPHERE	(12)	Btu/min	6906	6892	6507	6106
HEAT REJ. TO LUBE OIL (OC)	(12)	Btu/min	8879	8888	8569	8318
HEAT REJ. TO AFTERCOOLER (AC)	(12)(13)	Btu/min	16956	16956	8219	1851

COOLING SYSTEM SIZING CRITERIA						
TOTAL JACKET WATER CIRCUIT (JW)	(13)	Btu/min	19318			
TOTAL AFTERCOOLER CIRCUIT (OC+AC)	(13)(14)	Btu/min	28469			

A cooling system safety factor of 0% has been added to the cooling system sizing criteria.

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Max. rating is the maximum capability for the specified fuel at site altitude and reduced inlet air temperature. Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

Run 3 - intake man press -> 26 psi -> 52.94 in Hg

Pabs = 52.94 in Hg

by linear interpolation, est BHP => 1225.4 BHP

APPENDIX D

EPA Method 19 Calculations

Test Run	Fd Factor	BSFC	BHP	Avg O2 %	NOx PPM Corrected	CO PPM Corrected	NOx lbs/hr	CO lbs/hr	NOx gr/BHP-hr	CO gr/BHP-hr
1	8710	9400	1168.5	11.5	58.5	6.6	1.48	0.10	0.58	0.04
2	8710	9400	1223.9	11.5	59.9	6.9	1.59	0.11	0.59	0.04
3	8710	9400	1225.4	11.6	59.0	8.1	1.58	0.13	0.59	0.05
Average Levels			1205.9	11.5	59.1	7.2	1.55	0.12	0.58	0.04

APPENDIX E

FTIR Engine Test Sheet

Company Name	XTO
Location / Unit I.D.	RIBU 11-18 F #7
Type of Test Completed:	FTIR - 10. NOx, Hrsl @ 15% O2 . 3-lhr
Field Technician (s)	Jeff
Client Rep and/or State Rep	Derrick - XTO
Date:	9-18-13

	Test 1	Test 2	Test 3
Time of Readings	10:13 am	11:15 am	1:00 pm
Atm Pressure (in Hg)	24.76	24.74	24.72
Atm Temp (°F)	73	77	79
Engine RPM	985	984	985
*Manifold Pres. Vac(?) or Boost(psi)	25	26	26
Manifold Temp (°F)	141	143	144
Psuction (psi) Stage 1	32	32	32
Tsuction (°F) Stage 1	76	78	77
Pdischarge (psi) Stage 1	90	92	91
Psuction (psi) Stage 2	90	92	91
Tsuction (°F) Stage 2	88	89	89
Pdischarge (psi) Stage 2	292	299	298
Psuction (psi) Stage 3	297	299	298
Tsuction (°F) Stage 3	91	93	93
Pdischarge (psi) Stage 3	1050	1058	1055
Psuction (psi) Stage 4			
Tsuction (°F) Stage 4			
Pdischarge (psi) Stage 4			
Gas Throughput (mmcf/d)	SLE M	135	135
Pre CO (ppm)			
Pre Cat Temp (°F)	334	735	735
Post Cat Temp (°F)	735	737	738
Cat Differential Pres. (* of H2O)	2.2	2.1	2.2
Impinger 1 (grams)	/	/	/
Impinger 2 (grams)	/	/	/
Impinger 3 (grams)	/	/	/
Impinger 4 (grams)	/	/	/
Dry Gas Meter (cubic ft)	/	/	/
DGM Inlet Temp (deg F)	/	/	/
DGM Outlet Temp (deg F)	/	/	/
O2 %	11.5	11.5	11.6
CO2 %	5.6	5.5	5.5
LOAD %	CAT load	71	71
Delta H			
Ignition Timing (°F)	21.6	21.6	21.6
AFR Setting mV (Left Bank)			
AFR Setting mV (Right Bank)			
Upstream Port Distance (pd)			
Downstream Port Distance (pd)			
Exhaust Diameter (inches)			Cylinder Serial #↓
Propane	502		
NO	507		
CO	498.8		
NO2	150		
Ethylene	99		
Methane	505		
Acetaldehyde	25.99		
Engine Make	CAT		
Engine Model	3606		
Engine S/N	3XFO0121		

* Some units show boost in inches of Hg. In this situation please indicate if it is positive (+) or negative (-). Eg: (+12") or (- 5")

Rev 5

5/25/2011